CLAIMS

1. A method of fabricating a MOS transistor with a controllable and modulatable conduction path through a dielectric oxide layer, said transistor structure comprising said dielectric oxide layer formed between two silicon plates having surfaces, wherein, said silicon plates overhang said dielectric oxide layer all around to define an undercut having a substantially rectangular cross-sectional shape, said method comprising the steps of:

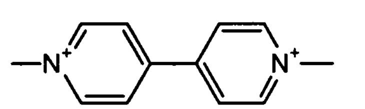
chemically altering respective surfaces of said silicon plates defining said undercut to provide at said undercut first functional groups;

chemically altering respective surfaces of said silicon plates outside of said undercut to provide second functional groups; and

selectively reacting said first functional groups provided at said undercut with an organic molecule having ends and a reversibly reducible center, thereby establishing a covalent bond to each end of said organic molecule.

2. A method according to claim 1 wherein said organic molecule has formula R_1-Y-R_1, wherein,

Y is a redox center having the following formula:



$2\,Z^-$

R_1 is a $-CH_2-(CHR_2)_n-R_3$ chain, wherein n=6-8;

R_2 is H or C_1-C_6 alkyl group;

R_3 is selected from the group consisting of $-CH_2-CH_2-X$, $-CH=CH_2$, $-C\equiv CH$, and $C\equiv N$, wherein X is either -SH or $-SiH_2Cl$; and

Z^- is a monovalent anion.

3. A method according to claim 2, wherein, n=7 in said organic molecule.

4. A method according to claim 3, wherein, R_2 = H, Z^- = Br^-, Cl^-, F^-, I^- or PF_6^-, and R_3 = $-CH=CH_2$, $-C\equiv CH$ or $-CH_2-CH_2-SiH_2Cl$ in said organic molecule.

5. A method according to claim 4, wherein, Z^- = Br^-, and R_3 = $-CH_2-CH_2-SiH_2Cl$ or $-CH=CH_2$ or $-C\equiv CH$ in said organic molecule.

6. A method according to claim 2 wherein the surfaces of said silicon plates in said undercut are chemically altered to have functional groups selected from the group consisting of -H, -OH, -Au, and $-NH_tR(2-_t)$, wherein, R is lower alkyl and t = 0, 1, or 2.

7. A method according to claim 6 wherein the surfaces of said silicon plates in said undercut are chemically altered to have -H functional groups, whereas said surfaces outside said undercut have -OH functional groups, and wherein R_3 = $-CH=CH_2$ or $-C\equiv CH$ in said organic molecule, said method comprising the steps of:

exposing the surfaces of said plates, as previously conventionally plasma etched and isotropically etched with aqueous HF, to hydrogen at a high temperature for a sufficiently long time to cleave all of the -OH terminations and hydrogenate the surfaces throughout;

anisotropically sputtering said plates to remove the hydrogen from the surfaces outside the undercut;

exposing said plates to air; and

exposing said plates to a solution of said organic molecule.

8. A method according to claim 6 wherein the surfaces of said silicon plates in said undercut are chemically altered to have -OH functional groups, whereas

said surfaces outside said undercut have -H functional groups, and wherein R_3 = --CH_2-CH_2-SiH_2Cl in said organic molecule, said method comprising the steps of:

exposing the surfaces of said plates, as previously conventionally plasma etched and isotropically etched with aqueous HF, to oxidation under O_2 at a high temperature until oxide as thick as a single layer is obtained;

anisotropically sputtering said plates to remove the oxygen from the surfaces outside the undercut;

exposing said plates to hydrogen at a high temperature for a sufficiently long time to form hydrogen terminations in the surfaces outside the undercut and form hydroxyl terminations in the surfaces of the undercut region; and

exposing said plates to a solution of said organic molecule.

9. The method according to claim 1 wherein the molecular length of said organic molecule substantially equals to a height measured by a distance between said silicon plates.

10. The method according to claim 9 wherein said organic molecule is about 3nm in length.

11. A method of fabricating a MOS transistor with a controllable and modulatable conductive path through a dielectric oxide layer, said transistor structure comprising said dielectric oxide layer formed between two silicon plates having surfaces, wherein, said silicon plates overhang said dielectric oxide layer all around to define an undercut having a substantially rectangular cross-sectional shape, said method comprising:

providing –H functional groups on respective surfaces of said silicon plates defining said undercut;

providing–OH functional groups on respective surfaces of said silicon plates outside of said undercut;

selectively reacting said –H functional groups provided at said undercut with an organic molecule having ends and a reversibly reducible center, thereby establishing a covalent bond to each end of said organic molecule.

12. The method according to claim 11 wherein said steps of providing said -H and –OH functional groups on the surfaces of said silicon plates comprises:

isotropically etching the surfaces of said silicon plates with aqueous HF;

exposing the surfaces of said silicon plates to hydrogen at a high temperature for a sufficiently long time to hydrogenate the surfaces of said silicon plates throughout;

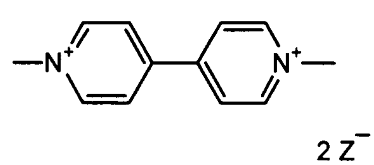
anisotropically sputtering said silicon plates to remove the hydrogen from the surfaces outside of said undercut;

exposing said plates to air; and

exposing said plates to a solution of said organic molecule.

13. The method according to claim 11 wherein said organic molecule has formula R_1-Y-R_1, wherein,

Y is a redox center having the following formula:



R_1 is a $-CH_2-(CHR_2)_n-R_3$ chain, wherein n=6-8;

R_2 is H or C_1-C_6 alkyl group;

R_3 is $-CH{=}CH_2$ or $-C{\equiv}CH$;

Z^- is a monovalent anion.

14. The method according to claim 11 wherein the molecular length of said organic molecule substantially equals to a height measured by a distance between said silicon plates.

15. The method according to claim 14 wherein said organic molecule is about 3 nm in length.

16. A method of fabricating a MOS transistor with a controllable and modulatable conductive path through a dielectric oxide layer, said transistor structure comprising said dielectric oxide layer formed between two silicon plates having surfaces, wherein, said silicon plates overhang said oxide layer all around to define an undercut having a substantially rectangular cross-sectional shape, said method comprising the steps of:

providing –OH functional groups on respective surfaces of said silicon plates defining said undercut;

providing –H functional groups on respective surfaces of said silicon plates outside of said undercut;

selectively reacting said –OH functional groups provided at said undercut with an organic molecule having ends and a reversibly reducible center, thereby establishing a covalent bond to each end of said organic molecule.

17. The method according to claim 16 wherein said steps of providing said –H and –OH functional groups on the surfaces of said silicon plates comprise:

isotropically etching the surfaces of said silicon plates with aqueous HF;

exposing the surfaces of said silicon plates to oxidation under O_2 at a high temperature until oxide as thick as a single layer is obtained;

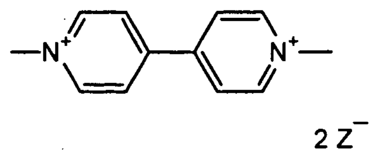
anisotropically sputtering said silicon plates to remove the oxygen from the surfaces outside the undercut;

exposing said plates to hydrogen at a high temperature for a sufficiently long time to form –H functional groups on the surfaces outside the undercut and form -OH functional groups on the surfaces of the undercut region; and

exposing said plates to a solution of said organic molecule.

18. The method according to claim 17 wherein the organic molecule has formula R_1-Y-R_1, wherein,

Y is a redox center having the following formula:



R_1 is a $-CH_2-(CHR_2)_n-R_3$ chain, wherein n=6-8;

R_2 is H or C_1-C_6 alkyl group;

R_3 is $-CH_2CH_2-SiH_2Cl$;

Z^- is a monovalent anion.

19. The method according to claim 16 wherein the molecular length of said organic molecule substantially equals to a height measured by a distance between said silicon plates.

20. The method according to claim 19 wherein said organic molecule is about 3nm in length.